## Science for a changing world

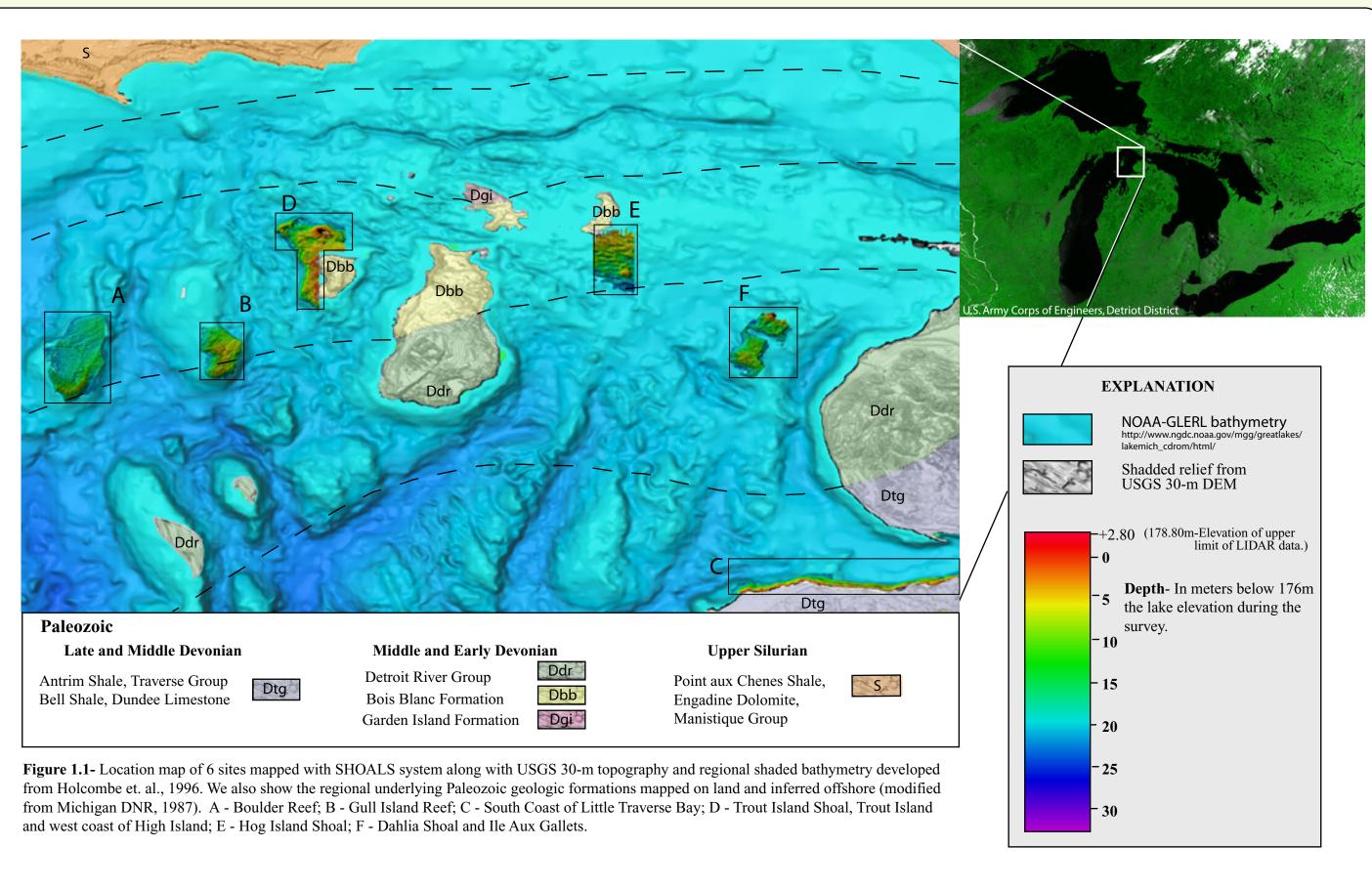
## Bathymetry and Selected Perspective Views of Selected Lake Trout Spawning Areas in Northern Lake Michigan

Open File Report 03-120 SHEET 1 of 2

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Peter Barnes, Guy Fleischer, James Gardner and Kristen Lee US Geological Survey Universal Traverse Mercator projection, Zone 16, WGS 84 ellipsoid Illumination  $315\infty$ ; elevation  $45\infty$  Vertical Exaggeration 10x Viewable with ChromaDepth 3D glasses

Land image generated from USGS 30-m DEM
Lake floor image generated from LIDAR elevation data below 178.80m (ref. IGLD 85)
Lake floor image generated from Regional NOAA-GLERL bathymetry and SHOALS bathymetry.
Data aquired on a four meter grid in August were collected and processed by J. E. Chance under contract to the Army Corp of Engineers and the U.S. Geological Survey.



Rubble with cobble

Sand w/rubble patches

Figure 2.2 - Surfical geology and habitat of the southwestern part of Boulder Reef (A in figure 1.1)

interpreted from side-scan sonar mosaic and video and mosiac (modified from Edsall et al., 1989).

Figure 4.2 - Oblique view looking southwest at nearshore off Big Rock Point. Rough irregular

bottom of image is about 2.1km.

morphology (bedrock outcrop?) draped with shore normal bedforms extends from the coast offshore to the edge of the survey, except in the far left foreground, which appears depositional. Distance across the

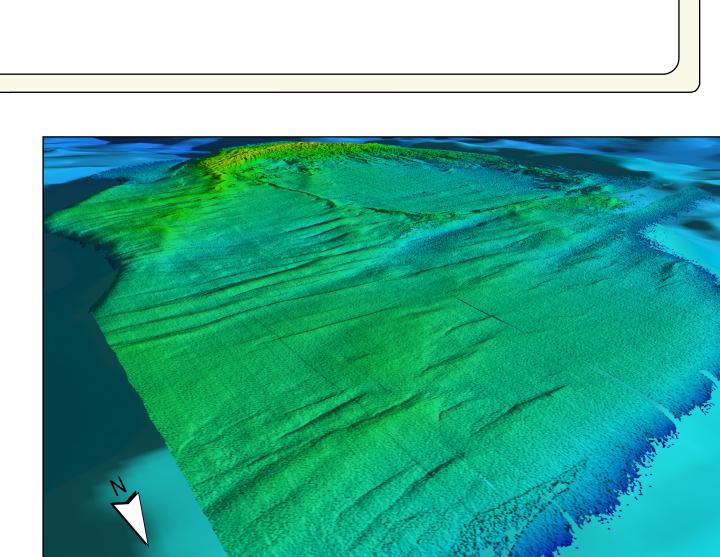


Figure 2.3 - Oblique view of Boulder Reef looking southwest (from upper right of figure 2.1) emphasizes the east-west lineations and smoother morphology of a sand draped surface on the northern part of the reef. A "window" of gravel/cobbles is likely in the foreground at the northern edge of the map. Distance across the bottom of image is about 3.0 km.

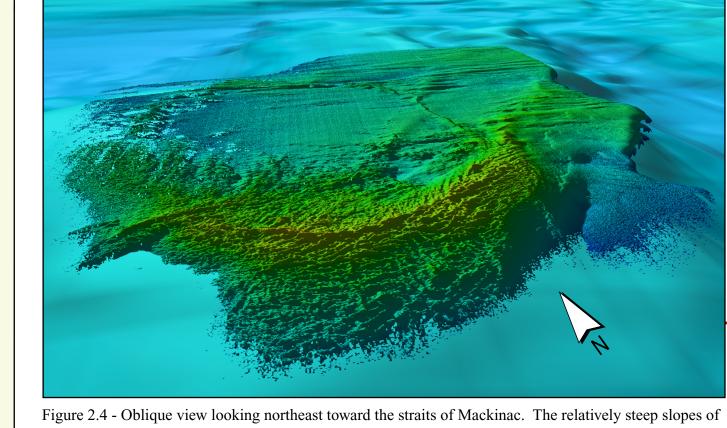


Figure 2.4 - Oblique view looking northeast toward the straits of Mackinac. The relatively steep slopes of the south end of the ridge and the different rough morphologic character of the cobble and gravel substrate fill the foreground. A small depositional apron of sand (video data) is forming off the southeast part of the reef. Distance across the bottom of image is about 2.9 km.

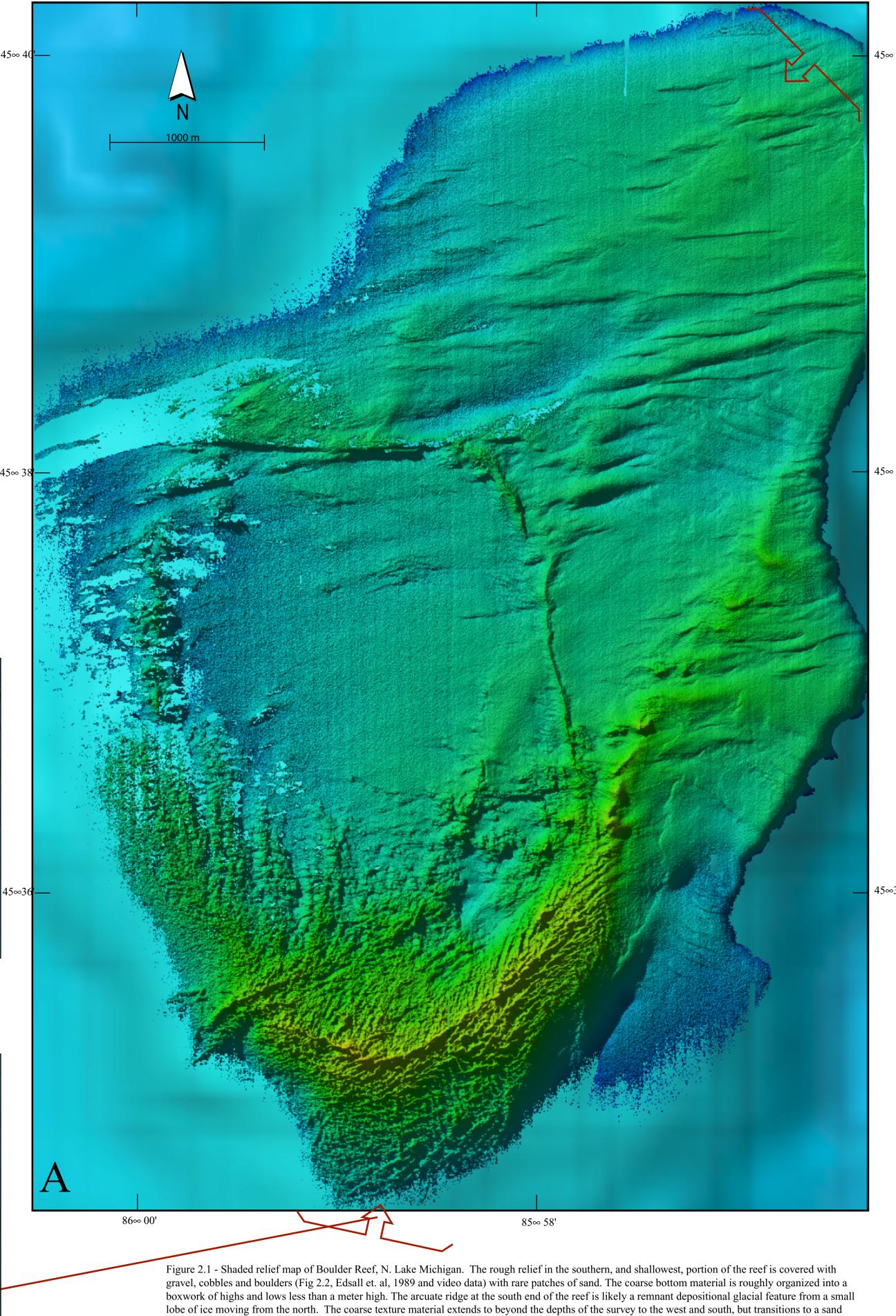
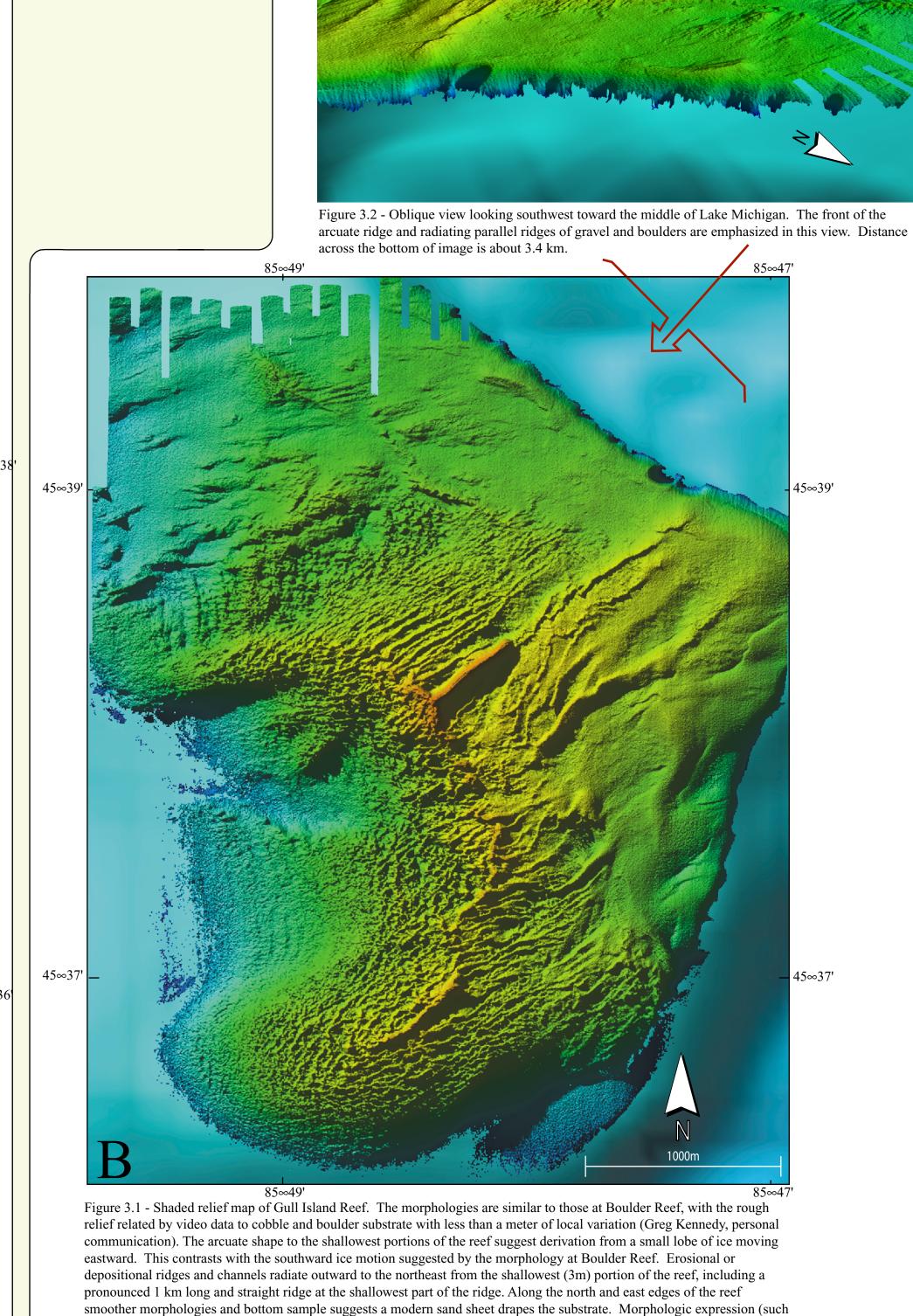


Figure 2.1 - Shaded relief map of Boulder Reef, N. Lake Michigan. The rough relief in the southern, and shallowest, portion of the reef is covered with gravel, cobbles and boulders (Fig 2.2, Edsall et. al, 1989 and video data) with rare patches of sand. The coarse bottom material is roughly organized into a boxwork of highs and lows less than a meter high. The arcuate ridge at the south end of the reef is likely a remnant depositional glacial feature from a small lobe of ice moving from the north. The coarse texture material extends to beyond the depths of the survey to the west and south, but transitions to a sand substrate to the east and north. (Video observations by Greg Kennedy, personal communication) The strong east west lineations in depths of 15-20 in m the northern half of the image could be related to either glacial movement but this is transverse to movement suggested by the ridge to the south, or to older glacial events or to the extrapolated underlying Devonian, Bois Blanc Formation (Fig.1). These lineations are drapped by sediment; sand with smooth morphologies. Clean sand was sampled in this part of the ridge. Underwater observations of Somers (1968) reports, "till generally is covered with sand, gravel, cobbles or boulders" from a dive near the south end of this reef. Note: The faint N-S lineations seen in the central part of the image are artifacts of the data gathering flight lines.



as along strike bedding and intraformational boundaries) of the pressumed underlying Detroit River Group and Bois Blanc

Formation (Fig. 1.1) are not obvious.

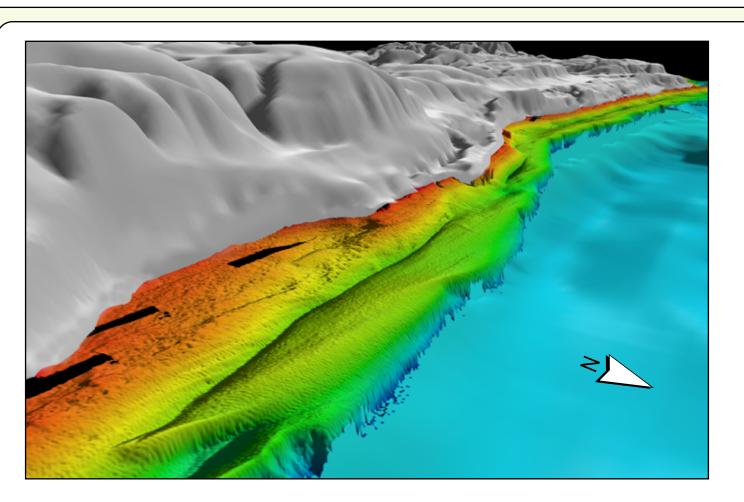


Figure 4.3 - Oblique view of the eastern portion of the Little Traverse Bay data set looking west along the coast. This view illustrates the rough relief of outcrops (?) and coarser (?) substrate material nearshore (reds and orange depths and the shore parallel offshore bar (green) in depths of 10-15m over lain by bar-normal bedforms (and shore normal) in the left foreground. Distance across the bottom of image is about 2.2 km. (Black strips on lidar are data gaps).

